MAR 1 8 1988

594 c-US FEM 1.209:500156

(N)

FLOOD INSURANCE STUDY

TOWN OF WEATHERSFIELD, VERMONT
WINDSOR COUNTY

BEST COPY AVAILABLE

JUNE 15, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 500156

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	9
3.0	ENGINEERING METHODS	10
	3.1 Hydrologic Analyses	10
	3.2 Hydraulic Analyses	11
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	13
	4.1 Floodplain Boundaries	13
	4.2 Floodways	13
5.0	INSURANCE APPLICATIONS	14
6.0	FLOOD INSURANCE RATE MAP	19
7.0	OTHER STUDIES	20
8.0	LOCATION OF DATA	20
9.0	BIBLIOGRAPHY AND REFERENCES	20

BEST COPY AVAILABLE

TABLE OF CONTENTS - continued

Page

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Flood Photograph 6

Figure 3 - Flood Photograph 6

Figure 4 - Flood Photograph 7

Figure 5 - Flood Photograph 7

Figure 6 - Flood Photograph 8

Figure 7 - Flood Photograph 8

Figure 8 - Floodway Schematic 18

TABLES

Table 1 - Summary of Discharges 11

Table 2 - Floodway Data 15 - 17

EXHIBITS

Exhibit 1 - Flood Profiles

Connecticut River	Panels 01P-04P	27-30
Black River	Panels 05P-08P	31-34
North Branch Black River	Panels 09P-12P	35-38

Exhibit 2 - Flood Insurance Rate Map Index and Street Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

iii

FLOOD INSURANCE STUDY
TOWN OF WEATHERSFIELD, WINDSOR COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the Town of Weathersfield, Windsor County, Vermont. This information will be used by the Town of Weathersfield to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study represent a revision of the original analyses prepared for the Federal Emergency Management Agency (FEMA). The updated hydrologic and hydraulic analyses were prepared by Dufresne-Henry, Inc., for FEMA under Contract No. EMW-C-5097. This work was completed in April 1986.

1.3 Coordination

In April 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of the Town of Weathersfield, FEMA, and Dufresne-Henry, Inc., (the study contractor) to determine the streams to be studied by detailed methods. During the preparation of this study, the Town of Weathersfield, the U. S. Army Corps of Engineers (COE), the Vermont Agency of Transportation, and the Vermont Department of Water Resources all provided pertinent information.

On January 8, 1987, the results of this study were reviewed at a final CCO meeting attended by representatives of FEMA, the Town of Weathersfield, the Vermont Department of Water Resources, and the study contractor.

BEST COPY AVAILABLE

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Weathersfield, Windsor County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: the Connecticut River, for its entire length within the community; the Black River, from the dam to the upstream corporate limits; and the North Branch Black River, from the upstream corporate limits to approximately 1,000 feet downstream of the State Route 131 bridge. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through April 1991.

Cooks Pond, Springfield Reservoir, Mill Brook, Barkmill Brook, portions of the Black River, Stoughton Pond, Beaver Pond, and North Springfield Reservoir were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Town of Weathersfield.

2.2 Community Description

The Town of Weathersfield is located in east central Windsor County, with a total land area of 43.5 square miles (Reference 1). The town is located on the Connecticut River approximately 40 miles north of the State of Massachusetts and 20 miles south of White River Junction. Weathersfield is bordered by the Towns of West Windsor and Windsor to the north; the City of Claremont, New Hampshire, to the east; the Town of Springfield to the south; and the Towns of Baltimore and Cavendish to the west. Weathersfield is comprised of numerous distinct district areas including Amsden, Ascutney, Downers, Greenbush, March District, Perkinsville, Weathersfield Bow, and Weathersfield Center. The 1980 population was 2,534, a 24 percent increase over the 1970 population of 2,040 (References 1 and 2).

The Connecticut River has a drainage area of 5,080 square miles. The floodplain area of the river in Weathersfield is very limited; a low-lying field in Weathersfield Bow is the only area subject to flooding.

The Black River flows from Black Pond in Plymouth to the Connecticut River in Springfield, a distance of approximately 37 miles. The maximum elevation in the 206 square mile watershed is approximately 3,600 feet on the divide with the Ottauquechee River. In Weathersfield the river drops from elevation 610 feet at the Weathersfield corporate limits to an elevation of approximately 475

BEST COPY AVAILABLE

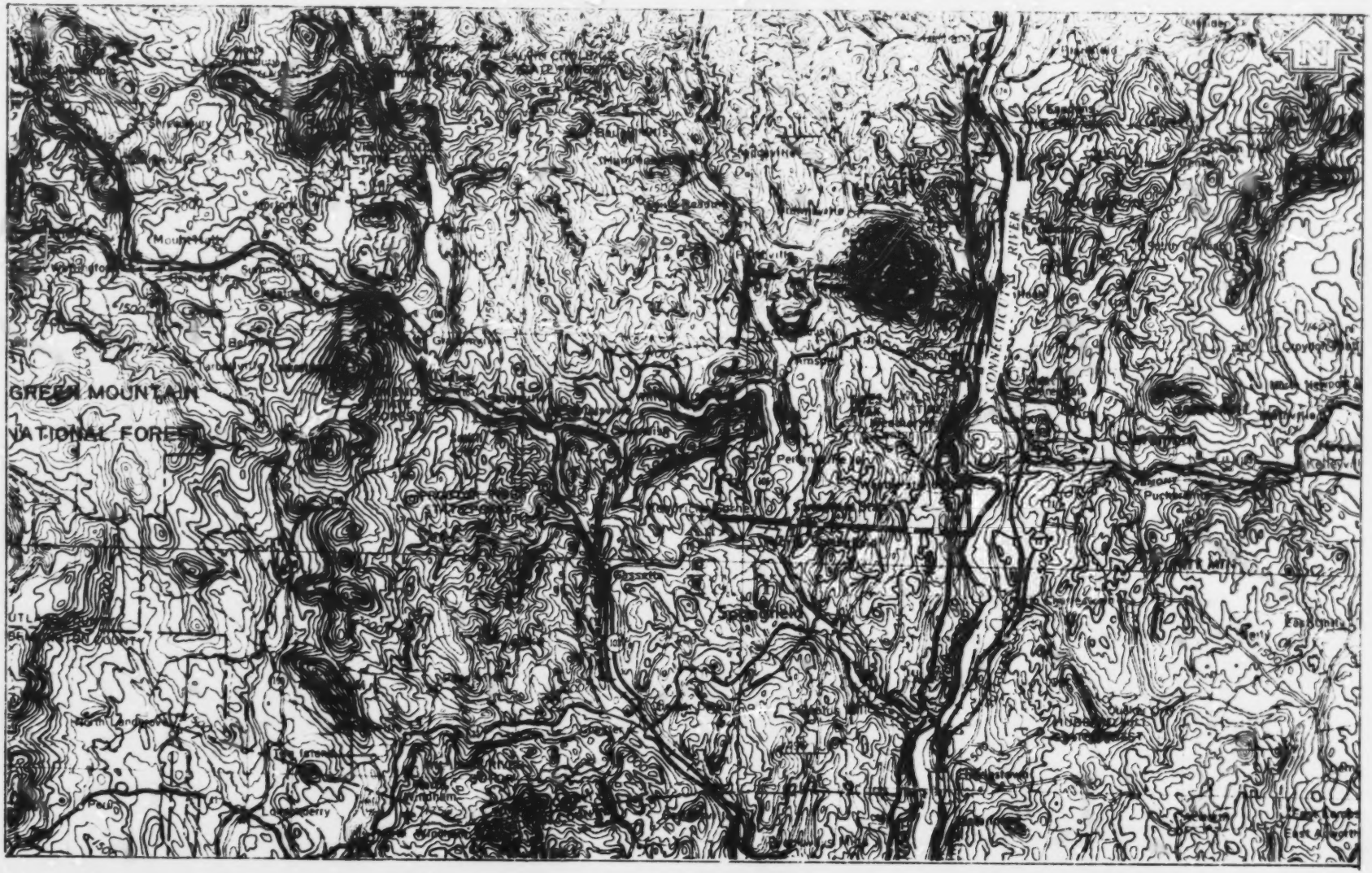


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

feet in the normal pool behind the North Springfield Dam. The flood control pool for the dam has an elevation of 545.5 feet, which is approximately 21 feet above the crest of the dam in Perkinsville. Development along the Black River is limited. Several homes are located along Upper Falls Road, but otherwise land use in the floodplain is agricultural or open land.

Development along the North Branch Black River is primarily agricultural, with several residences along State Route 106, Amsden Schoolhouse Road, and State Route 131.

The North Branch Black River begins at the confluence of Darby Brook and Alder Meadow Brook in South Reading. From South Reading to Felchville, a distance of approximately 3 miles, the river drops quickly from an elevation of 1,200 to 700 feet. In Felchville, through the northeast corner of Cavendish, and to Ascutney Basin Road in Weathersfield the river has a moderate slope and a deep, well-defined channel. From Ascutney Basin Road to State Route 106 in Amsden the floodplain expands to approximately 2,000 feet and the stream gradient is flat and meandering. Below the falls at Amsden the slope returns to moderate for the last 1.5 miles before the river empties into Stoughton Pond.

Weathersfield lies in the New England upland physiographic province that is characterized by irregular, often rugged topography. The area is a plateau-like region that has been dissected by streams and crossed by continental glaciers several times (Reference 3). The upland areas of the town are covered with a thin mantle of glacial till with numerous exposures of bedrock. Along the Connecticut River, the valley bottom is covered with a layer of lacustrine sands and gravels deposited in the post-glacial Connecticut Valley Lake. This material extends up the Black River to Downers and the North Branch Black River to Amsden. Through much of these stream lengths, the lacustrine deposits have been eroded down to glacial outwash gravels along the streams. Above Amsden, the broad North Branch Black River floodplain is covered with a thin layer of recent stream alluvium (References 3 and 4).

2.3 Principal Flood Problems

Flood damages in Weathersfield occur both as inundation by floodwaters and erosion along streams and roadways. The area around Weathersfield has experienced significant floods in 1869, 1927, 1936, 1938, 1973, 1976, and 1984. For much of the region the 1927 flood caused the most extensive damage of record. The storm causing the 1927 flood produced approximately 7.4 inches of rain in Woodstock and approximately 8 inches in Cavendish (Reference 5). It is likely that significant flooding occurred in Weathersfield, but, compared to surrounding communities, damage may have been light because records documenting that flood in the town are scarce.

The 1936 and 1938 floods were regional in impact and produced nearly equal record stages along the Connecticut River in the area flowing through Weathersfield. At the Ascutney Bridge then in place, a stage of 323.9 feet was recorded on March 19, 1936 (Reference 6). This level is approximately 5 feet above the 100-year flood level shown in this study. On the Black River in North Springfield the 1936 flood produced a peak discharge of 14,700 cubic feet per second (cfs) and the 1938 flood a peak discharge of 15,500 cfs (References 6 and 7).

By all accounts, the floods of June 30 and July 4, 1973, eclipsed the severity of any previous floods along all streams in Weathersfield, except the Connecticut River. The COE estimates that downstream in North Springfield a peak discharge of 24,000 cfs would have occurred had it not been for their flood control dam (Reference 8). The events were well covered by the local newspaper, The Weathersfield Weekly, to include a special supplement published later in the summer from which the following photographs and most of the following information was obtained (Reference 9). In total, the subsequent floods on June 30 and July 4, 1973, caused approximately $200,000 damage to Weathersfield roads and, in excess of $80,000 damage to streams. Few roads in town did not sustain some damage. State Route 131 was washed out along Mill Brook and the Black River and was flooded over by North Branch Black River in Amsden. Flooding from that stream also covered the entire length of Amsden Schoolhouse Road, several hundred feet of State Route 106, Little Ascutney Road, and Ascutney Basin Road. The Black River along Upper Falls Road changed its course and washed away a substantial length of the roadway. The hardest hit area was along Tarbell Hill Road, where Tarbell Brook washed out approximately 2.5 miles of the road and deposited a sizeable delta at its mouth in Greenbush. Flood photographs during and following the floods of 1973 are shown in Figures 2, 3, 4, 5, 6, and 7.

The rainfall that caused the 1973 floods was officially recorded by the COE at North Springfield Dam as 5.36 feet on June 29 and 30, followed by 1.75 feet on July 4 and 5. Unofficial estimates upstream in Greenbush reported 7 inches by Saturday, June 30, followed by 4.35 inches in an 8 hour period on July 4 (Reference 9).

In August 1976, Weathersfield was flooded again though not as severely as in 1973. Amsden Schoolhouse Road and State Route 106 were flooded and impassable. State Route 131 at the Cavendish-Weathersfield corporate limits was again washed out. As in 1973, the most severe damage was sustained in Greenbush along Tarbell Brook where a beaver dam reportedly failed and caused the subsequent failure of the dam at Collins Pond (Reference 10).

In May 1984, approximately 6.5 inches of rain fell over a 3 day period causing flooding of the fields along State Route 106 north of Amsden and the closing of Ascutney Basin Road (Reference 11). Future flooding in Weathersfield is almost a certainty, particularly

Figure 2 - The Black River along State Route 131 near the Weathersfield corporate limits at the Town of Cavendish during the flood of June 30, 1973 flood. Photo by Weathersfield Weekly.

Figure 3 - The North Branch Black River flowing down State Route 131 in Amsden during the flood of July 4, 1973. Photo by Weathersfield Weekly.

BEST COPY AVAILABLE

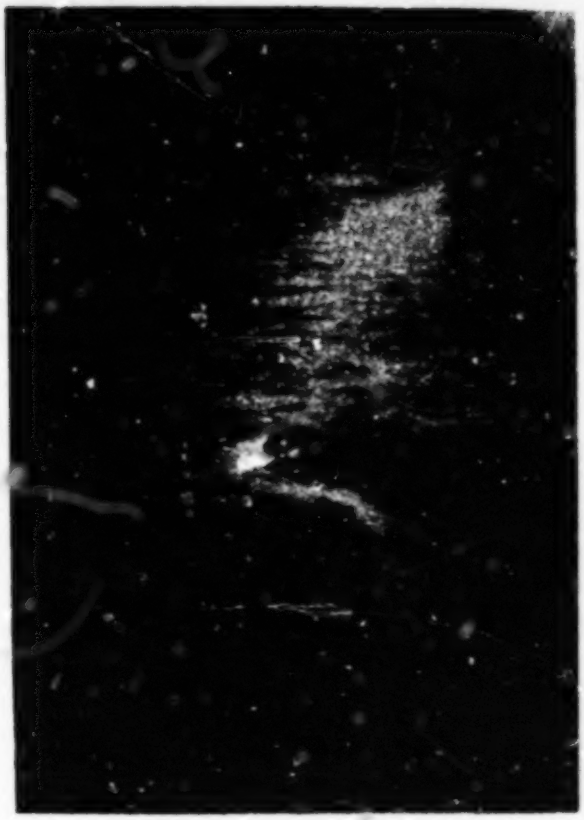


Figure 4 - Looking north along Amsden Schoolhouse Road from the intersection with State Route 131 near the time of the flood peak, July 4, 1973. Photo by Weathersfield Weekly.

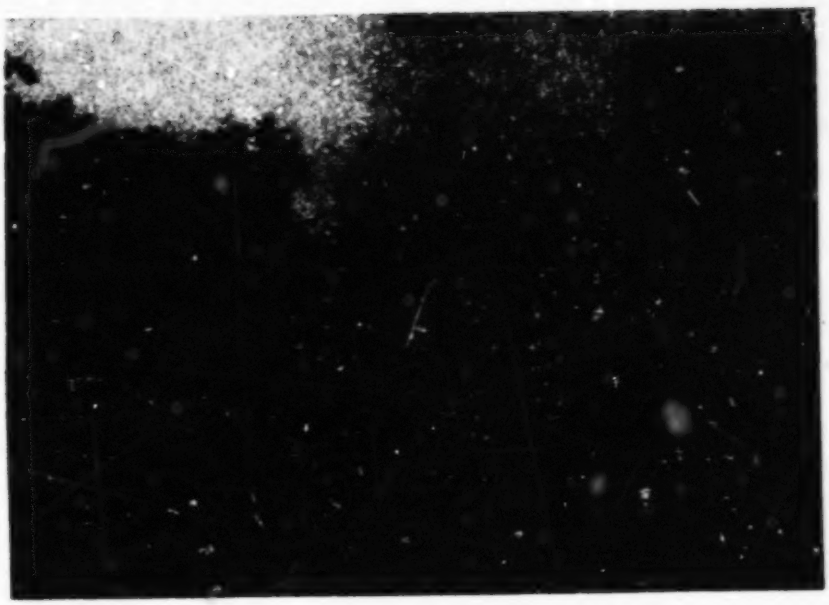


Figure 5 - North along State Route 106 above Downers where acres of land were under water at the intersection of State Route 106 and Amsden Schoolhouse Road, July 4, 1973. Photo by Weathersfield Weekly.

BEST COPY AVAILABLE

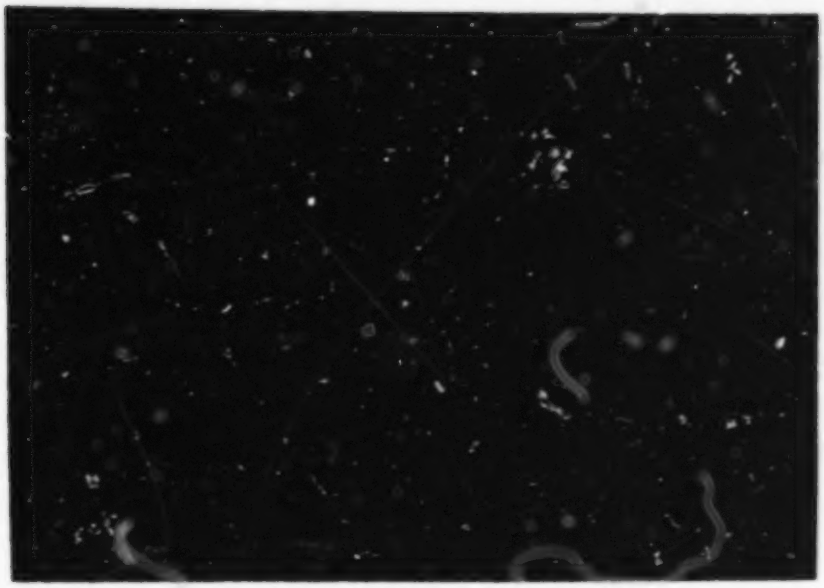


Figure 6 - The Hammond home just northeast of the Ascutney Basin Road bridge over the North Branch Black River following the 1973 floods. The road was washed away during both storms. Photo by Weathersfield Weekly.

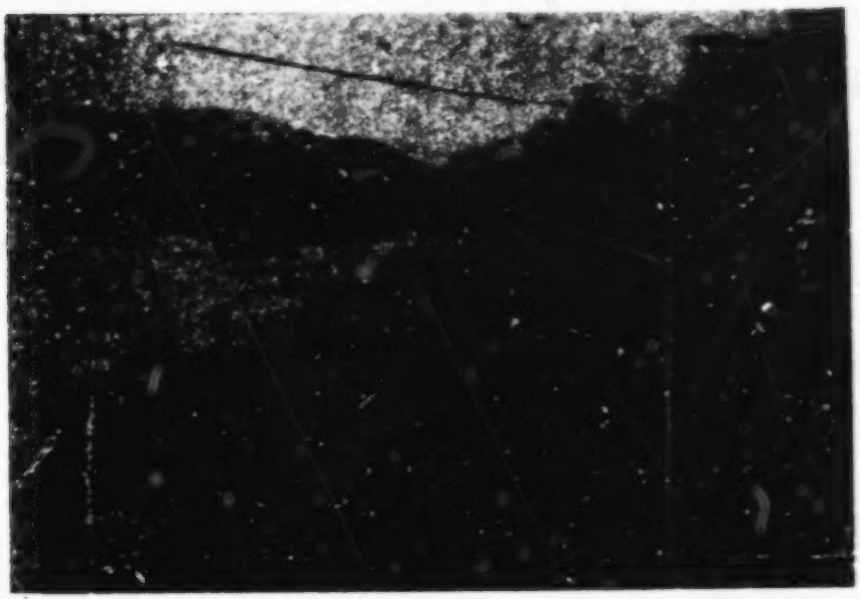


Figure 7 - The Black River along Upper Falls Road, following 1973 floods where the course changed and covered fields with silt and mud. Photo by Weathersfield Weekly.

BEST COPY AVAILABLE

along North Branch Black River. The substantial land area covered with recent stream deposited soils are a sure indication of repeated floodings. Elsewhere in town along the steeper streams such as Tarbell Brook, Mill Brook, and the Black River above Downers, erosion will continue to be the primary problem associated with flood flows.

2.4 Flood Protection Measures

Two flood control dams built and operated by the COE regulate a portion of the Connecticut River watershed upstream of Weathersfield. Union Village Dam on the Ompompanoosuc River controls a 126 square mile drainage area and will store 5.6 inches of runoff. North Hartland Dam on the Ottauquechee River controls a 220 square mile drainage area and will store 6 inches of runoff. The COE estimates that the combined effect of these dams can reduce major floods on the Connecticut River in Weathersfield by 16 percent (Reference 12).

Flows on the Black River are regulated to a very slight degree by four small flood control reservoirs built by the Soil Conservation Service (SCS) on Jewell Brook in Ludlow. No additional flood control structures are present upstream of Weathersfield on the Black River or the North Branch Black River. At several locations along the North Branch Black River, earthen dikes have been placed in an attempt to direct flood flows away from certain properties. While such structures may successfully control frequent flood events, they would have little impact on the infrequent floods that are the basis for flood insurance rates. FEMA specifies that all levees must have a minimum of 3 foot freeboard against 100-year flooding to be considered a safe flood protection structure. These structures do not meet the criteria required by FEMA for recognition as local control structures.

The broad, flat floodplain of the North Branch Black River acts as a natural flood storage area that causes a significant reduction in flood peaks at Amsden and downstream. It is estimated that the 100-year flood is only 60 percent of what it could be at Amsden without this storage effect.

The COE North Springfield Dam and Reservoir is located a short distance downstream of Weathersfield on the Black River. While the dam provides no relief to Weathersfield by reduction of flood peaks, land acquired or reserved for flowage easement occupies a significant area in Weathersfield. In order to build and operate their structure, the COE purchased all land above the dam that is below the elevation of 520 feet and maintains flowage easement on additional land up to an elevation of 550 feet (Reference 13).

Flood warnings and statements of anticipated weather conditions are issued by the National Weather Service in Burlington, Vermont, and the River Forecast Center in Bloomfield, Connecticut, to radio and

BEST COPY AVAILABLE

television stations and the local press for dissemination to the public. The Weathersfield Civil Defense has a disaster plan for evacuation and shelter that is coordinated through the Vermont Civil Defense office in Montpelier. This plan was tested and proved adequate during the 1973 floods and was in a standby condition again in 1976.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

For the Connecticut River, hydrologic data were adopted directly from the Claremont, New Hampshire, Flood Insurance Study (Reference 12). The COE supplied the specific discharges used in that study.

Peak discharges for the Black River were obtained by transposition of the discharges adopted for the Cavendish, Vermont, Flood Insurance Study (Reference 14). Peak discharges for the Cavendish study were based on discharges developed by the SCS for Ludlow, Vermont, and on USGS records of the 1973 flood in Weathersfield near the Cavendish corporate limits. Discharges were transposed by the following equation:

$$Q_2 = Q_1(A_2/A_1)^{0.75}$$

Where Q equals the discharge and A is the area; "1" is used as a known point, and "2" is the point of interest.

Initial discharges for the North Branch Black River were also determined by transposition of discharges adopted from the Cavendish Flood Insurance Study (Reference 14). However, use of these discharges produced flood elevations in Amsden well above those experienced in 1973. The 1973 floods had estimated recurrence intervals between 50 to 100 years in the Black River watershed (Reference 8). It is clear that a substantial volume of storage is present in the floodplain from Ascutney Basin Road to Amsden. Insufficient detailed data is available to prepare a flood routing exercise to evaluate the effect of this storage on flood peaks, and it is also beyond the scope of this study; therefore, a simple ponding adjustment technique described by the SCS was used to adjust the transposed discharges (Reference 15). The results indicate a 40 percent reduction in the transposed 100-year discharge at Amsdent is appropriate. The reduced discharges produce elevations much closer to those actually experienced in 1973.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CONNECTICUT RIVER					
At downstream corporate limits	5,080.0	73,000	102,000	116,000	154,000
BLACK RIVER					
At abandoned dam in Perkinsville	117.0	8,745	15,440	19,130	30,600
NORTH BRANCH BLACK RIVER					
At downstream corporate limits	27.5	3,125	5,250	6,160	9,170
Upstream of eastern tributary above State Route 131	24.2	2,715	4,600	5,150	8,020
Approximately 1,300 feet downstream of Ascutney Basin Road	18.0	3,365	5,940	7,360	11,560

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Overbank areas of cross sections for the analysis of the Connecticut River were obtained by field survey in November 1975. Below water elevations were estimated. Cross sections for the Black River and the North Branch Black River were obtained from aerial photographs and supplemented by field surveys of structures and selected sections (Reference 16).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals on the Black River and the North Branch Black River were computed using the COE HEC-2 step-backwater computer program (Reference 17). Water-surface elevations on the Connecticut River were taken from the Claremont FIS (Reference 12). That study applied rating data from the New England Power Company to the discharges supplied by the COE to develop the elevations. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for these streams were determined by the slope/area method

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations of the river and floodplain area. These values were compared with values contained in the USGS Water Supply Paper 1849 and the U. S. Department of Commerce Hydraulic Design Series Number 4 (References 18 and 19). The following tabulation lists channel and overbank "n" values for the streams studied by detailed methods:

Stream	Channel	Overbank
Connecticut River	0.028	0.060-0.130
Black River	0.035-0.060	0.055-0.090
North Branch Black River	0.040-0.050	0.050-0.080

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimina[illegible] the 1 percent annual chance (100-year) flood has been adopted by the base flood for floodplain management purposes. The 0.2 perce[illegible] annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:25,000 with a contour interval of 6 meters, and topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (References 20 and 21).

For the streams studied by approximate methods, the 100-year flood boundaries were delineated using the previous Flood Insurance Study for the Town of Weathersfield (Reference 22).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway

fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 8.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Connecticut River								
A	0[1]	751[3]	24,564	5.0	311.6	311.6	312.6	1.0
B	8,600[1]	676[3]	21,359	5.7	313.6	313.6	314.6	1.0
C	10,200[1]	1,726[3]	31,058	3.9	314.0	314.0	315.0	1.0
D	12,900[1]	595[3]	19,936	6.1	314.6	314.6	315.6	1.0
E	29,300[1]	1,414[3]	33,792	3.6	318.5	318.5	319.5	1.0
F	31,550[1]	590[3]	21,352	5.5	318.9	318.9	319.9	1.0
G	40,610[1]	607[3]	18,592	6.3	320.0	320.0	320.0	0.0
Black River								
A	35[2]	221	2,693	7.1	534.3	534.3	534.8	0.5
B	290[2]	197	2,013	9.5	534.4	534.4	534.9	0.5
C	585[2]	212	2,210	8.7	536.4	536.4	536.7	0.3
D	1,000[2]	167	2,100	9.1	538.2	538.2	538.2	0.0
E	2,240[2]	765	5,970	3.2	540.3	540.3	541.2	0.9
F	4,085[2]	420	1,936	9.9	543.1	543.1	543.6	0.5
G	5,705[2]	493	4,042	4.7	550.4	550.4	551.2	0.8
H	7,655[2]	913	2,385	8.0	556.8	556.8	557.3	0.5
I	9,035[2]	748	3,364	5.7	566.6	566.6	567.5	0.9
J	10,415[2]	167	1,688	11.3	575.4	575.4	575.7	0.3
K	11,075[2]	161	1,541	12.4	582.9	582.9	582.9	0.0
L	11,265[2]	159	1,582	12.1	584.8	584.8	584.8	0.0

[1]Feet above corporate limits
[2]Feet above dam
[3]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWN OF WEATHERSFIELD, VT
WINDSOR COUNTY

FLOODWAY DATA

CONNECTICUT RIVER-BLACK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Black River (continued)								
M	12,755[1]	157	1,886	10.1	598.0	598.0	598.0	0.0
N	14,600[1]	141	1,679	11.4	611.2	611.2	611.3	0.1
North Branch Black River								
A	235[2]	94	650	9.5	564.3	564.3	564.3	0.0
B	640[2]	91	555	11.1	569.0	569.0	569.2	0.2
C	860[2]	56	404	15.2	589.8	589.8	589.8	0.0
D	1,115[2]	134	1,051	5.9	596.8	596.8	596.8	0.0
E	1,485[2]	193	1,705	3.6	597.5	597.5	597.6	0.1
F	2,080[2]	375	3,253	1.6	597.7	597.7	598.0	0.3
G	3,150[2]	690	5,170	1.0	597.8	597.8	598.2	0.4
H	4,555[2]	515	4,693	1.1	597.8	597.8	598.3	0.5
I	5,380[2]	720	4,412	1.2	597.8	597.8	598.3	0.5
J	7,120[2]	929	1,922	2.7	598.0	598.0	598.9	0.9
K	7,480[2]	905	2,502	2.1	599.9	599.9	600.4	0.5
L	8,450[2]	1,165	1,829	4.2	600.8	600.8	601.7	0.9
M	9,650[2]	1,200	2,931	2.6	604.2	604.2	604.9	0.7
N	10,485[2]	880	2,231	3.5	605.4	605.4	606.3	0.9
O	11,760[2]	679	2,855	2.7	607.5	607.5	608.5	1.0
P	13,695[2]	787	2,622	2.9	610.1	610.1	610.6	0.5
Q	15,450[2]	900	1,304	5.6	615.5	615.5	616.2	0.7

[1]Feet above dam

[2]Feet above downstream corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

WINDSOR COUNTY

FLOODWAY DATA

BLACK RIVER-NORTH BRANCH BLACK RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
North Branch Black River (continued)								
R	16,160	520	1,211	6.1	620.6	620.6	620.8	0.2
S	16,635	490	1,426	5.2	623.3	623.3	623.6	0.3
T	16,920	125	700	10.0	626.0	626.0	626.5	0.5
U	17,390	126	973	7.6	631.2	631.2	631.2	0.0
V	17,830	75	556	13.0	633.0	633.0	633.2	0.2
W	18,425	81	655	11.2	641.1	641.1	641.6	0.5
X	19,300	87[2]	523	14.1	653.0	653.0	653.0	0.0

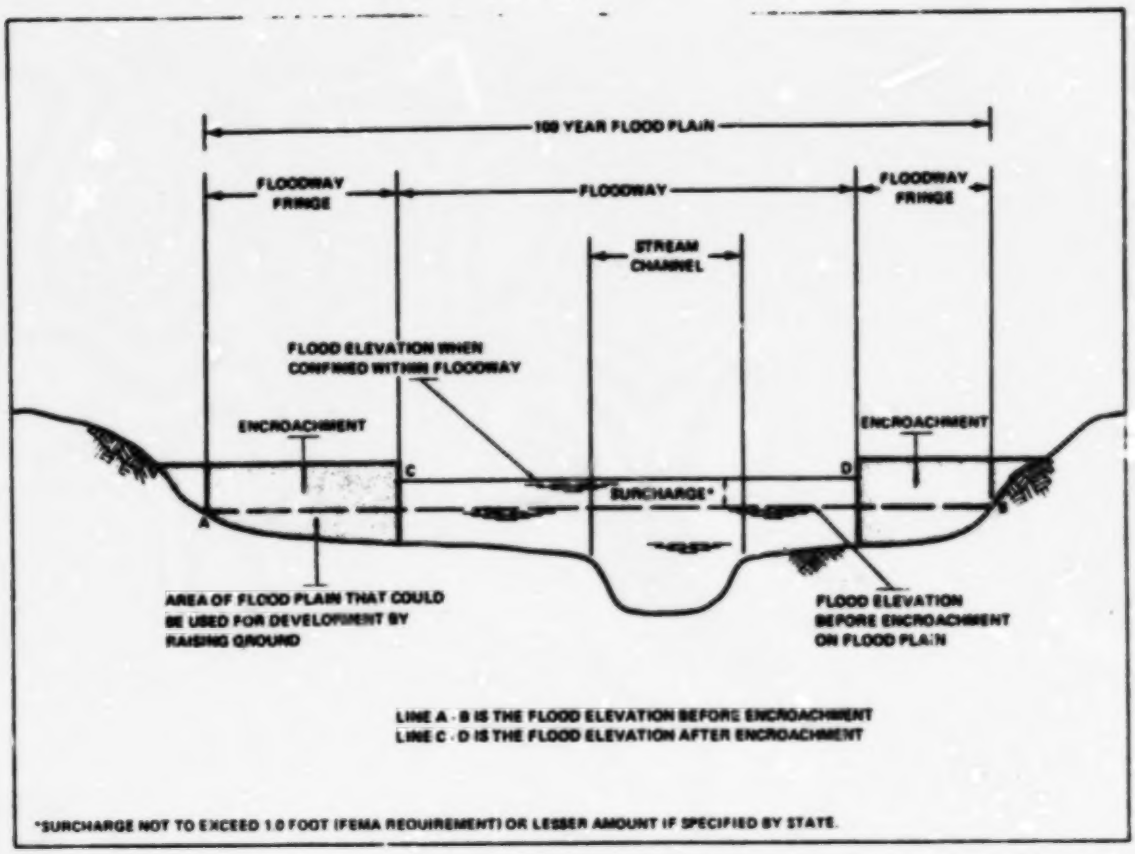
[1]Feet above downstream corporate limits
[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWN OF WEATHERSFIELD, VT
WINDSOR COUNTY

FLOODWAY DATA

NORTH BRANCH BLACK RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 8

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

BEST COPY AVAILABLE

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies for the City of Claremont and the Towns of Cavendish and Springfield have been published (References 12, 14, and 23). The results of this study will be in exact agreement with the results of those studies.

A Flood Insurance Study for the Town of Windsor is currently being prepared (Reference 24). The results of that study will be in exact agreement with the results of this study.

Due to its more up-to-date analyses, this study supersedes the previous Flood Insurance Study for the Town of Weathersfield (Reference 22).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Vermont, Washington, D. C., U. S. Government Printing Office, 1981.

2. The National Survey, Vermont Yearbook 1985, Chester, Vermont.

3. Vermont Geological Survey, Environmental Geology No. 7, Geology for Environmental Planning the Brattleboro-Windsor Region, Vermont by David P. Stewart, 1975.

4. State of Vermont, "Surficial Geologic Map of Vermont," Scale 1:250,000, 1970.

5. U. S. Department of the Interior, Geological Survey, Water Supply Paper 636-C, The New England Flood of November, 1927 by H. G. Kinnison, Washington, D. C., 1929.

6. U. S. Department of the Interior, Geological Survey, Water Supply Paper 798, The Floods of March 1936, Part 1 New England Rivers by Nathan C. Grover, Washington, D. C., 1937.

7. U. S. Department of the Interior, Geological Survey, Water Supply Paper 867, Hurricane Floods of Srior, Geological Survey, Water Supply Paper 798, The Floods of March 1936, Part 1 New England Rivers by Nathan C. Grover, Washington, D. C., 1937.

7. U. S. Department of the Interior, Geological Survey, Water Supply Paper 867, Hurricane Floods of September 1938 by Carl G. Paulsen, Washington, D. C., 1940.

8. U. S. Army Corps of Engineers, New England District, Hydrologic Report for the Flood of June-July 1973, Waltham, Massachusetts, 1974.

9. The Weathersfield Weekly, Hunter Press, Weathersfield, Vermont, September, 1973.

10. The Weathersfield Weekly, Weathersfield, Vermont, Page 8, August 13, 1976.

11. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological Data for New England, Volume 96, Number 5, Asheville, North Carolina, National Climatic Center, May 1984.

12. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Claremont, Sullivan County, New Hampshire, Washington, D. C., February 15, 1984.

13 U. S. Army Corps of Engineers, New England Division, Connecticut River Flood Control Master Manual of Reservoir Regulation, Appendix "C", Black River Watershed, Waltham, Massachusetts, October 1968.

14. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Cavendish, Windsor County, Vermont, Washington, D. C., April 15, 1981.

15. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, Washington, D. C., January 1975.

16. Lockwood Support Services, Inc., Aerial Photographs, Scale 1:9,600: Weathersfield, Vermont, April 26, 1985.

17. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, November 1976, Updated March 1982.

18. U. S. Department of the Interior, Geological Survey, Water Supply Paper 1849, Roughness Characteristics of Natural Channels by Harry H. Barnes, Jr., Washington, D. C. 1967.

19. U. S. Department of Commerce, Bureau of Public Roads, Hydraulic Design Series No. 4, Design of Roadside Drainage Channels, Washington, D. C., May 1965.

20. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:25,000, Contour Interval 6 Meters: Mount Ascutney, Vermont-New Hampshire, 1984 (Provisional); Springfield, Vermont-New Hampshire, 1984 (Provisional).

21. Lockwood Support Services, Inc., Topographic Maps compiled from aerial photographs, Scale 1:2,400, Contour Interval 5 Feet: Weathersfield, Vermont, April 1985.

22. Federal Emergency Management Agency, Flood Insurance Study, Town of Weathersfield, Windsor County, Vermont, Washington, D. C., September 18, 1985.

23. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Springfield, Windsor County, Vermont, Washington, D. C., December 4, 1979.

24. Federal Emergency Management Agency, Flood Insurance Study, Town of Windsor, Windsor County, Vermont (Unpublished).

The Sunday Rutland Herald and the Sunday Times Argus, "By 1975, Vermont had 471,000 Residents," May 22, 1977.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	01	621.58	From intersection of State Routes 106 and 131 north on State Route 106 approximately 2.2 miles to Ascutney Basin Road and mark. TBM is an 8 inch spike in west face of power pole number 4/10/86.
RM 2	03	606.93	From intersection of State Routes 106 and 131 north on State Route 106 approximately 1.1 miles to intersection of Little Ascutney Road and Tarbell Hill Road to mark. TBM is an 8 inch spike in northeast face of power pole number 1/15/28A.
RM 3	03	498.40	From intersection of State Routes 106 and 131, east on State Route 131 approximately 0.6 mile to bridge and to mark. TBM is chiseled square on bridge abutment on southeast quad of bridge.
RM 4	03	614.15	Intersection of State Routes 106 and 131 also known as "Downers Four Corners." TBM is a chiseled square in northwest corner of concrete base of "Gulf" sign.
RM 5	11	641.24	From intersection of State Routes 106 and 131, west on State Route 131 approximately 1.1 miles to rest area and to mark. TBM is standard USGS survey disk on boulder on north side of State Route 131.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

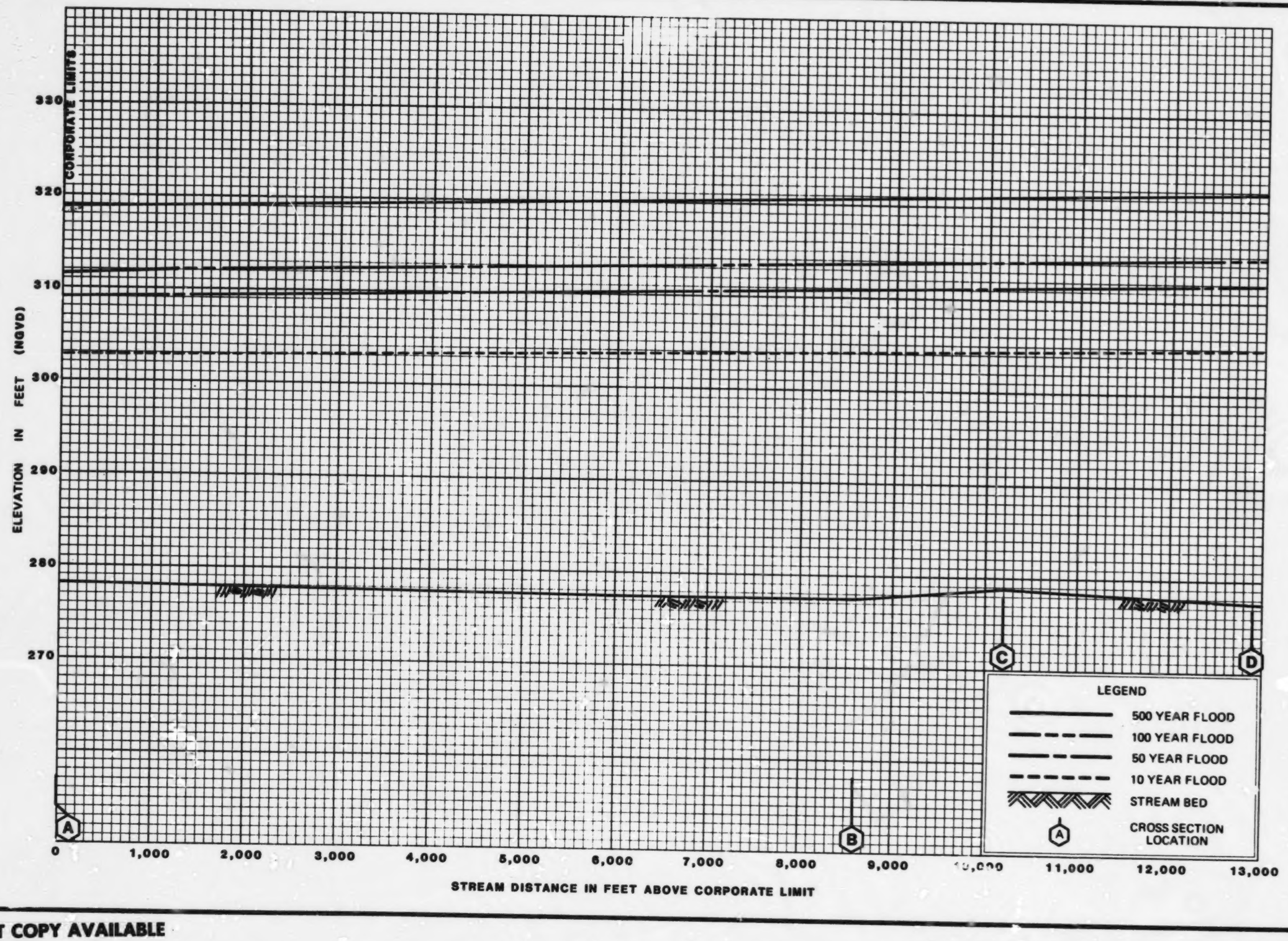
Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 6	03	603.50	From intersection of State Routes 106 and 131 west on State Route 131 approximately 0.45 mile to TBM. TBM in a chiseled square on marble headwall north of State Route 131 and on southeast quad of wall.
RM 7	03	599.23	From intersection of State Routes 106 and 131 west on State Route 131 approximately 0.15 miles to southbound road. South on road approximately 200 feet to covered bridge and mark. TBM is chiseled square in northeast quad of bridge abutment.
RM 8	11	561.58	From intersection of State Routes 106 and 131 south on State Route 106 approximately 1.9 miles over bridge to Perkinsville, to Upper Falls Road. North on Upper Falls Road approximately 1.4 miles to mark. TBM in an 8 inch spike in east face of power pole 13/32.
RM 9	11	572.34	From intersection of State Routes 106 and 131 south on State Route 106 approximately 1.9 miles over bridge to Perkinsville to Upper Falls Road. North on Upper Falls Road approximately 0.6 mile to mark. TBM is spike in west face of 36 inch maple tree.
RM 10	11	560.70	Chiseled square on southwest abutment of State Route 106 bridge over Black River.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 11	10	382.62	In Weathersfield, 0.95 mile north along U. S. Route 5 from post office in Ascutney to mark on left, set behind power pole number 58112-40-T, 378-152, with a brace pole, 30 feet northeast of center of entrance road to Country Estates, Inc., 3 feet northeast of a witness post, a disk stamped Q 53 1978.
RM 12	10	413.95	In Weathersfield, set in front of post office in Ascutney, in median along side of power pole number 250-1, 191-1, 0.05 mile north of the junction of State Route 106 and State Route 131, 51 feet west of centerline of U. S. Route 5, 1 foot southwest of the power pole, a disk stamped P 53 1978.
RM 13	20	333.25	In Weathersfield, 1.6 miles south along U. S. Route 5 from post office in Ascutney to mark on left, set between two power poles numbers 241-X and 241, 2 feet northeast of an NGS witness post, a disk stamped M 53 1978.
RM 14	20	357.42	In Weathersfield, 1.45 miles north along U. S. Route 5 from church in Weathersfield Bow to mark on left, set in bedrock 1 foot above highway, 100 feet north of power pole number 1-260-5-274, 18.9 feet west of centerline of highway, a disk stamped L 53 1978.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 15	20	350.50	In Weathersfield, 0.7 mile north along U. S. Route 5 from church in Weathersfield Bow to mark on left, set in bedrock 4 feet above highway, 188 feet west and across highway from power pole number 66, 27 feet southwest of centerline of highway, 6 feet south of NGS witness post, a disk stamped K53 1978.



FLOOD PROFILES

CONNECTICUT RIVER

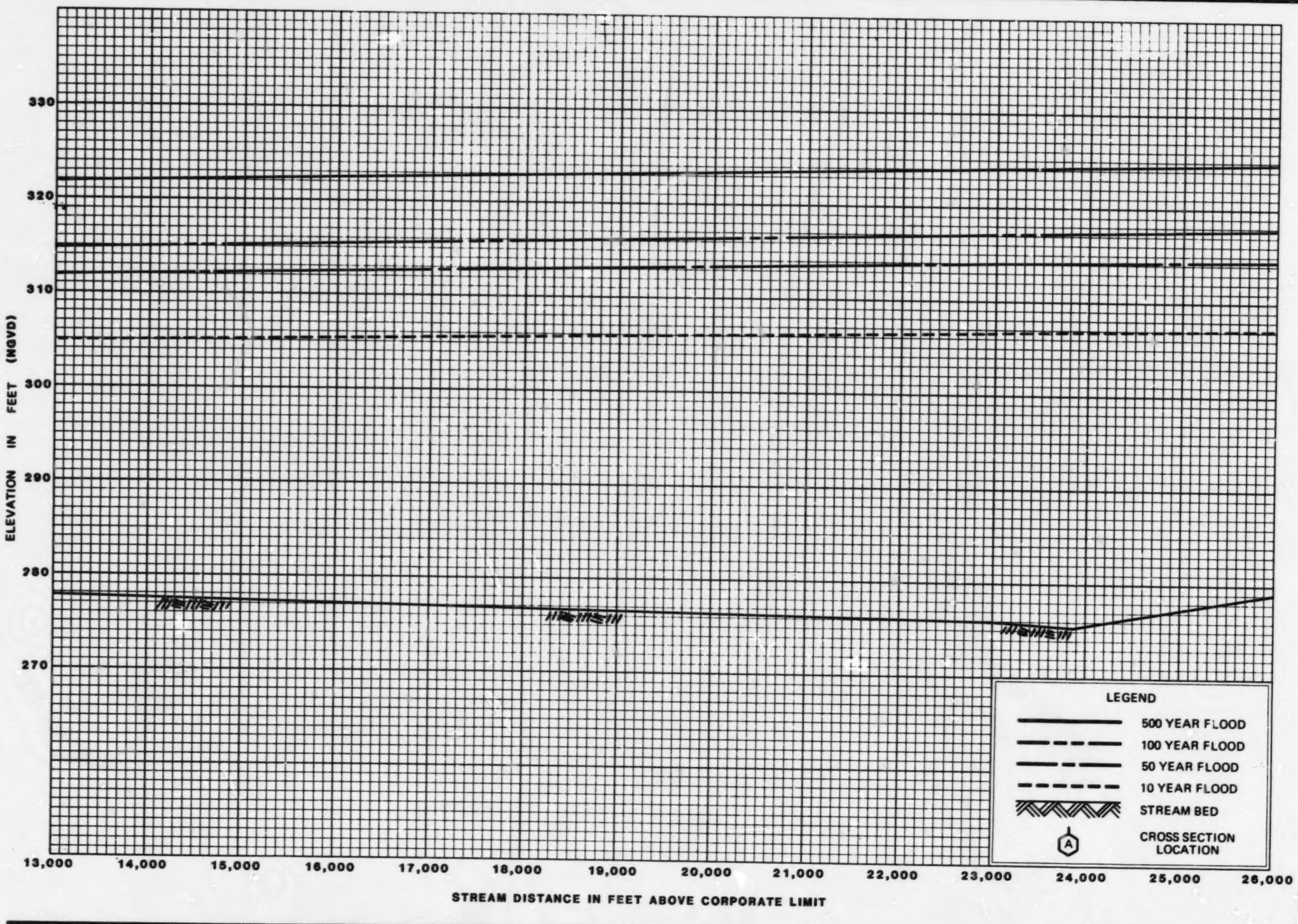
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

01P

BEST COPY AVAILABLE



FLOOD PROFILES

CONNECTICUT RIVER

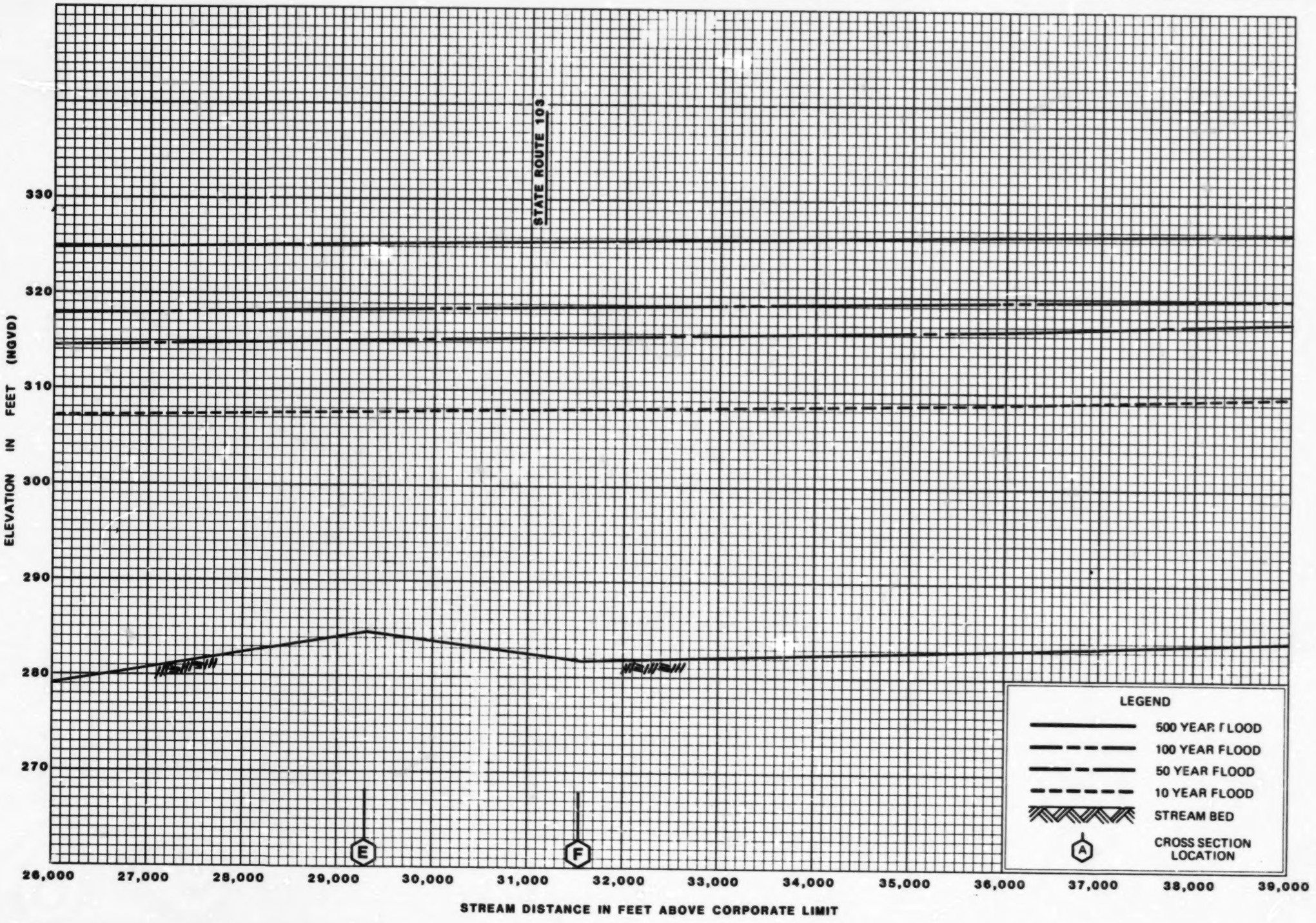
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

02P

BEST COPY AVAILABLE



FLOOD PROFILES

CONNECTICUT RIVER

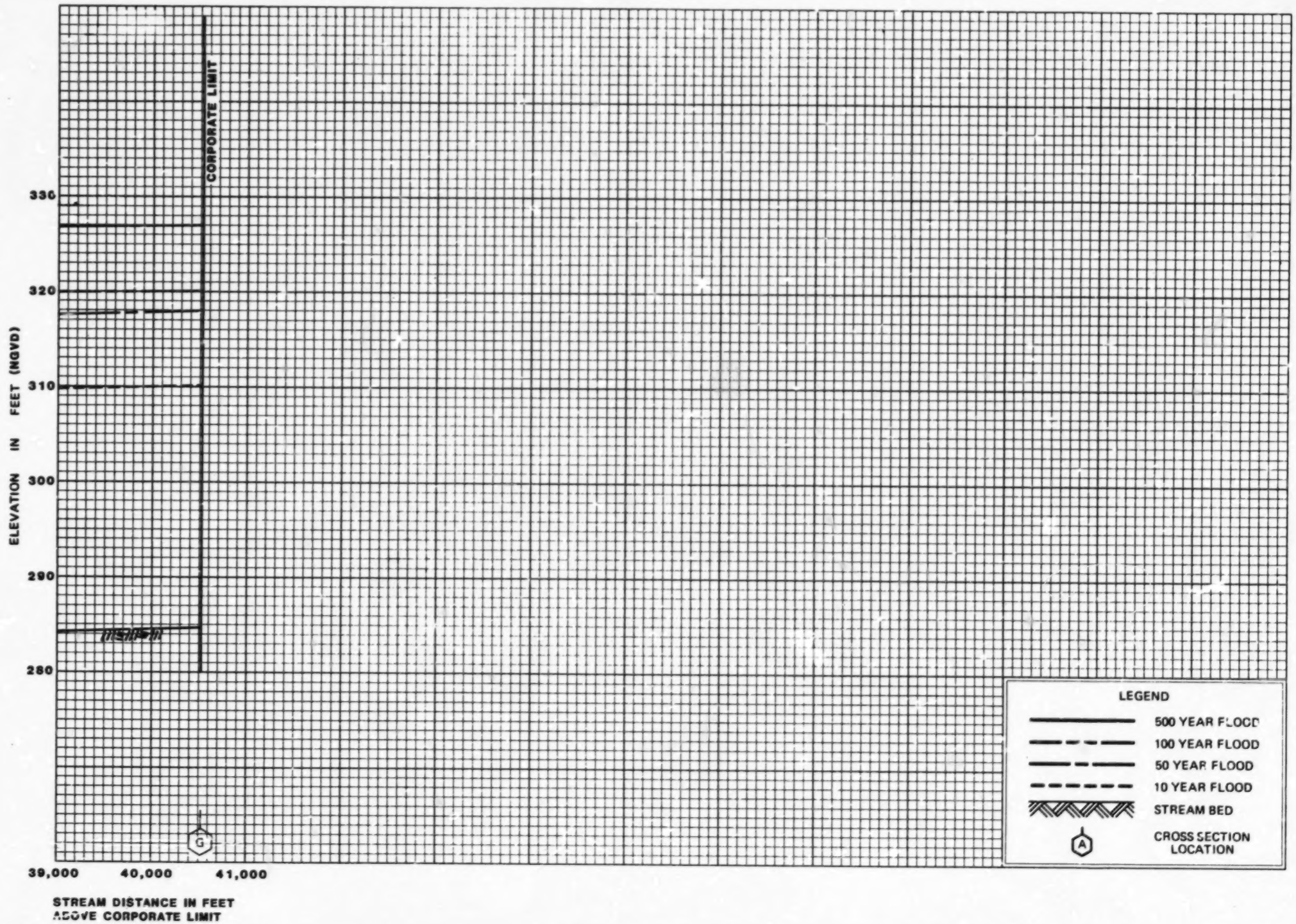
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

03P

BEST COPY AVAILABLE



FLOOD PROFILES

CONNECTICUT RIVER

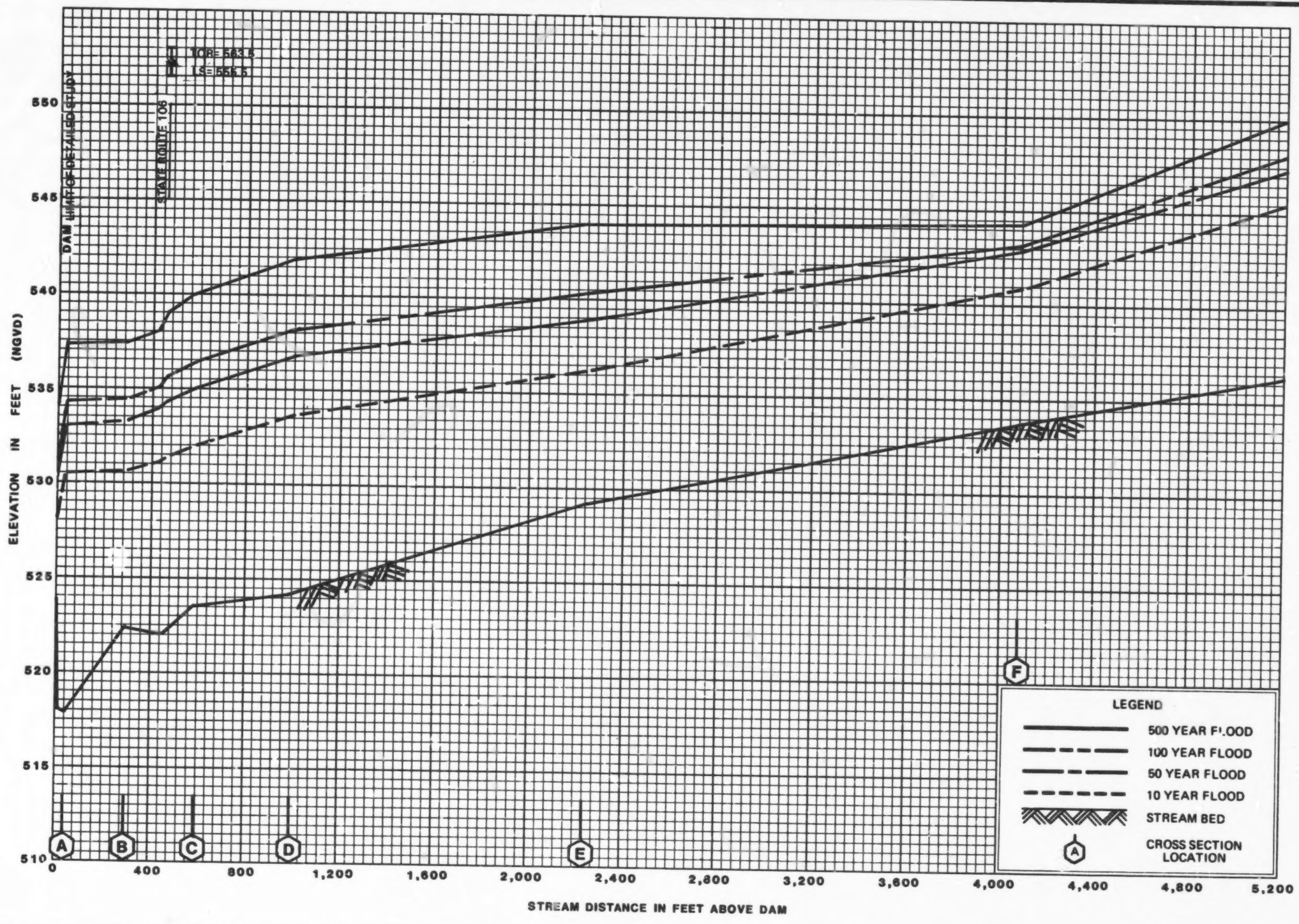
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

04P

BEST COPY AVAILABLE



FLOOD PROFILES

BLACK RIVER

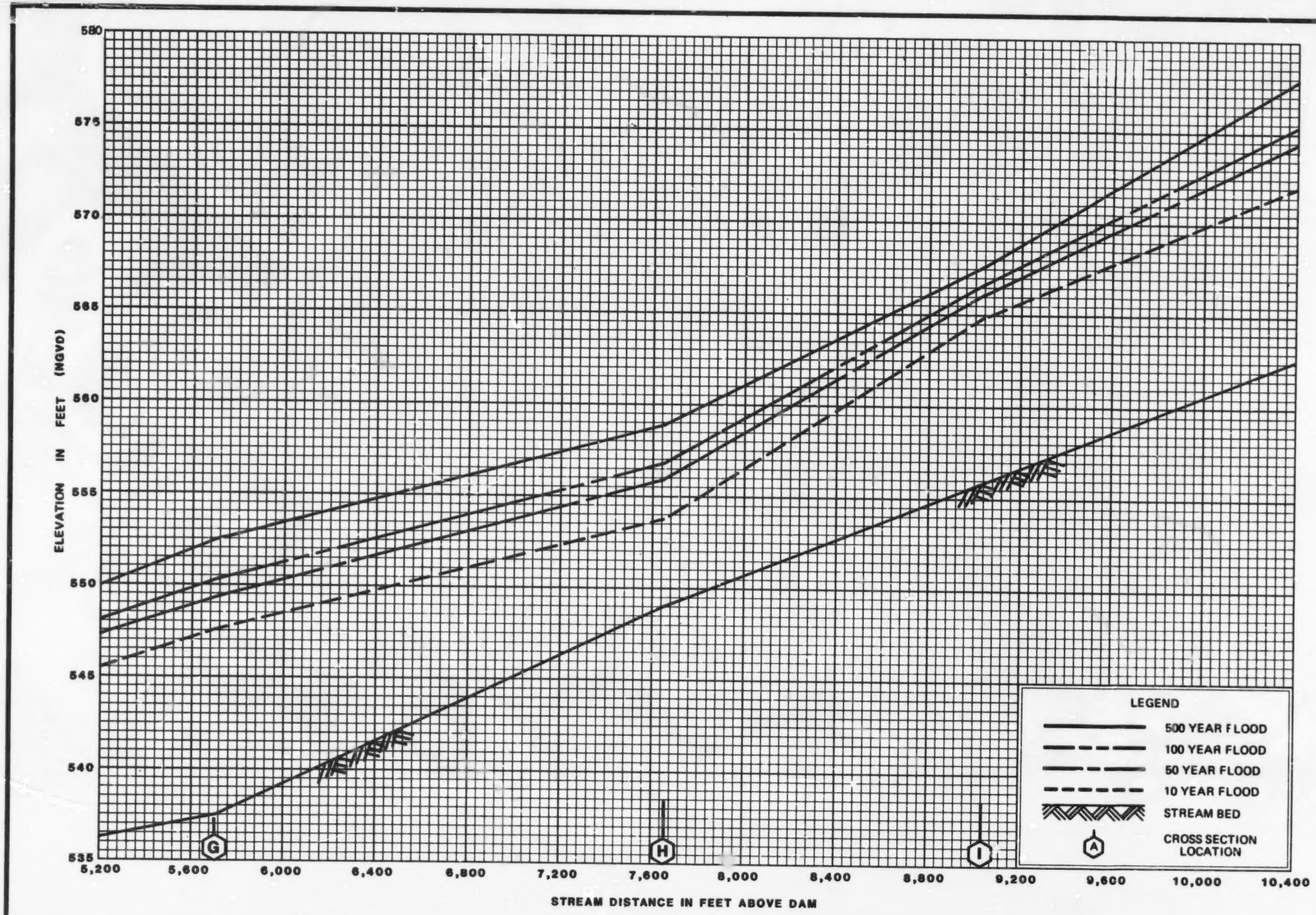
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

05P

BEST COPY AVAILABLE



FLOOD PROFILES

BLACK RIVER

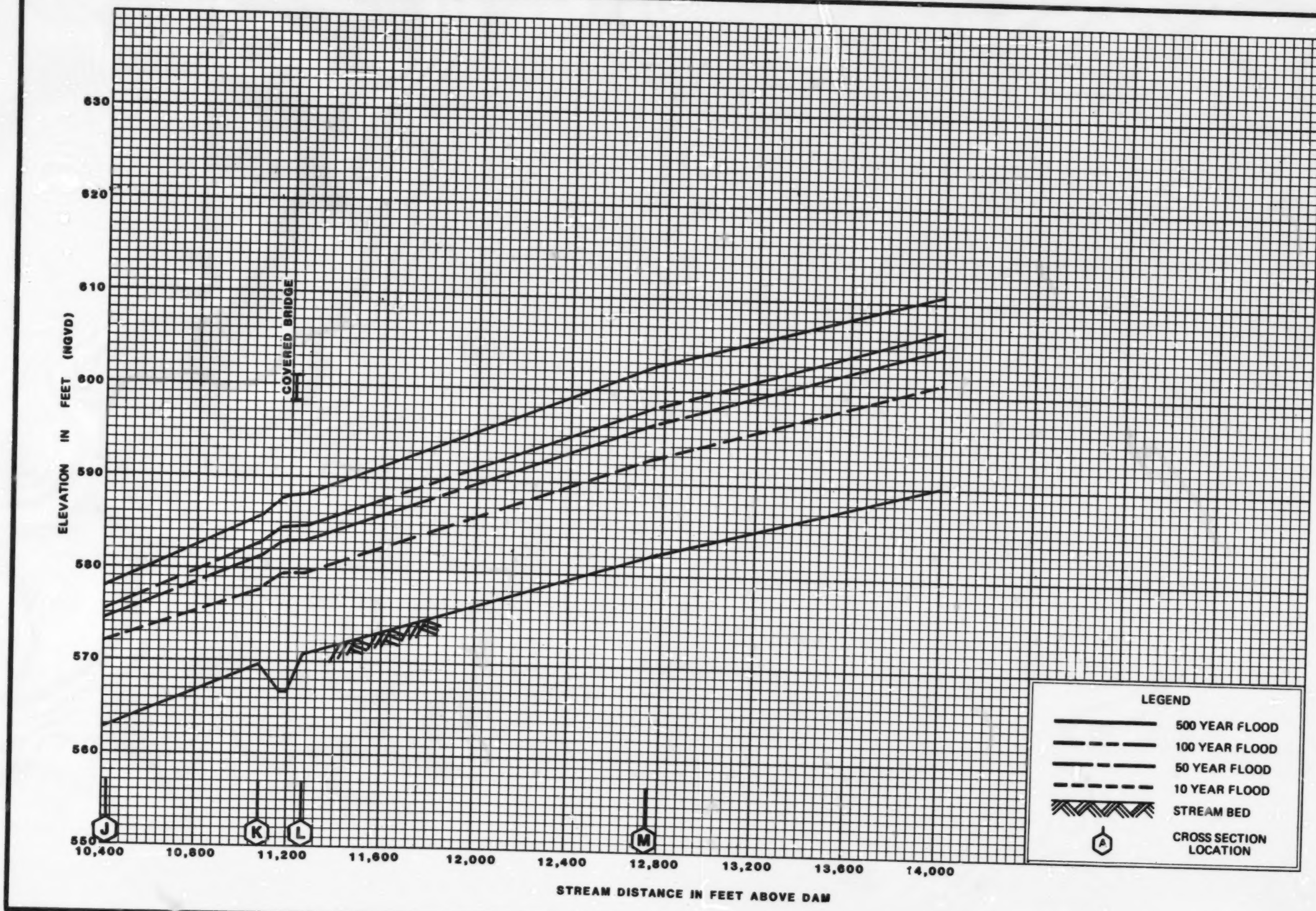
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

06P

BEST COPY AVAILABLE



FLOOD PROFILES

BLACK RIVER

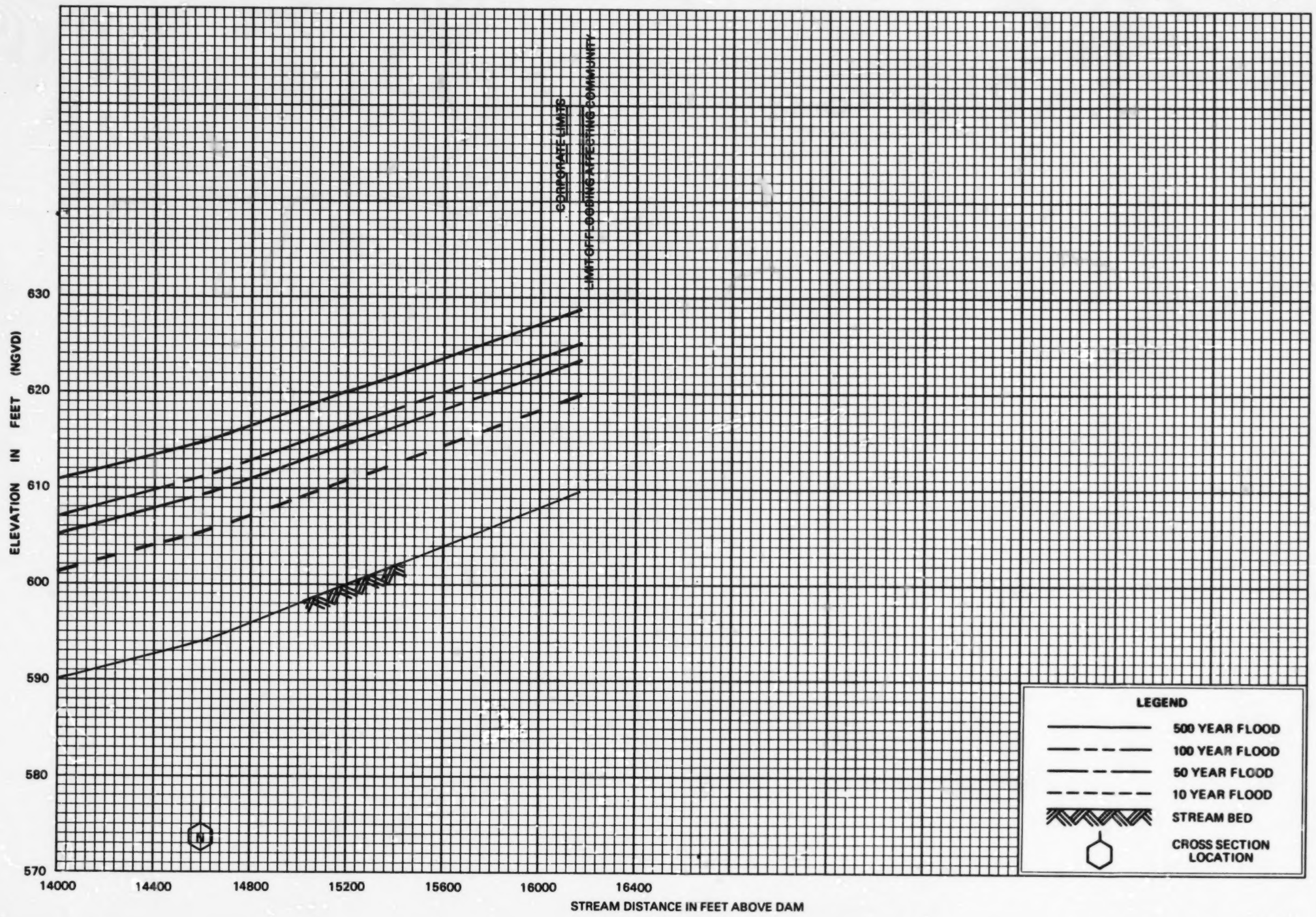
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

07P

BEST COPY AVAILABLE



FLOOD PROFILES

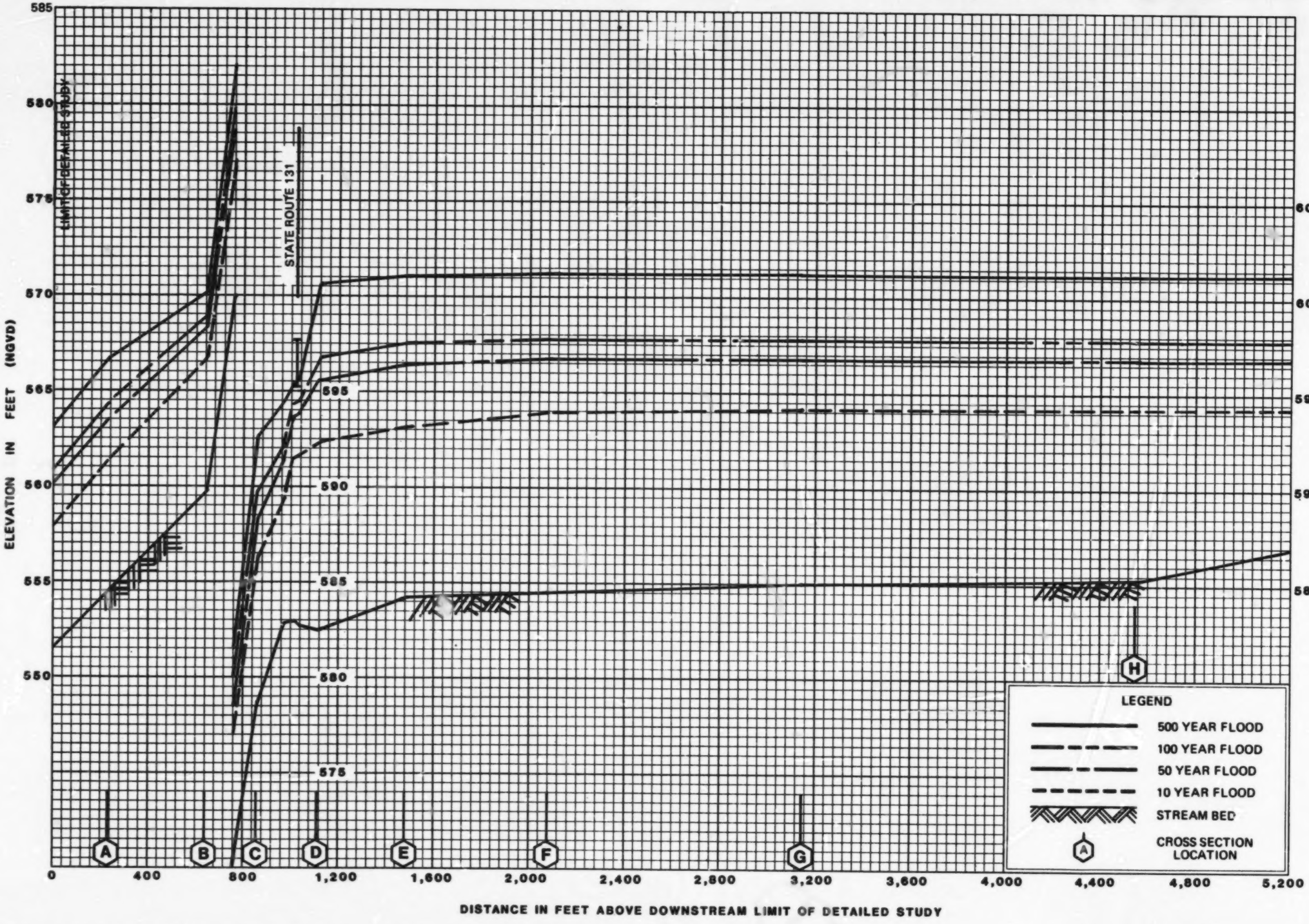
BLACK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT
(WINDSOR CO.)

08P

BEST COPY AVAILABLE



FLOOD PROFILES

NORTH BRANCH BLACK RIVER

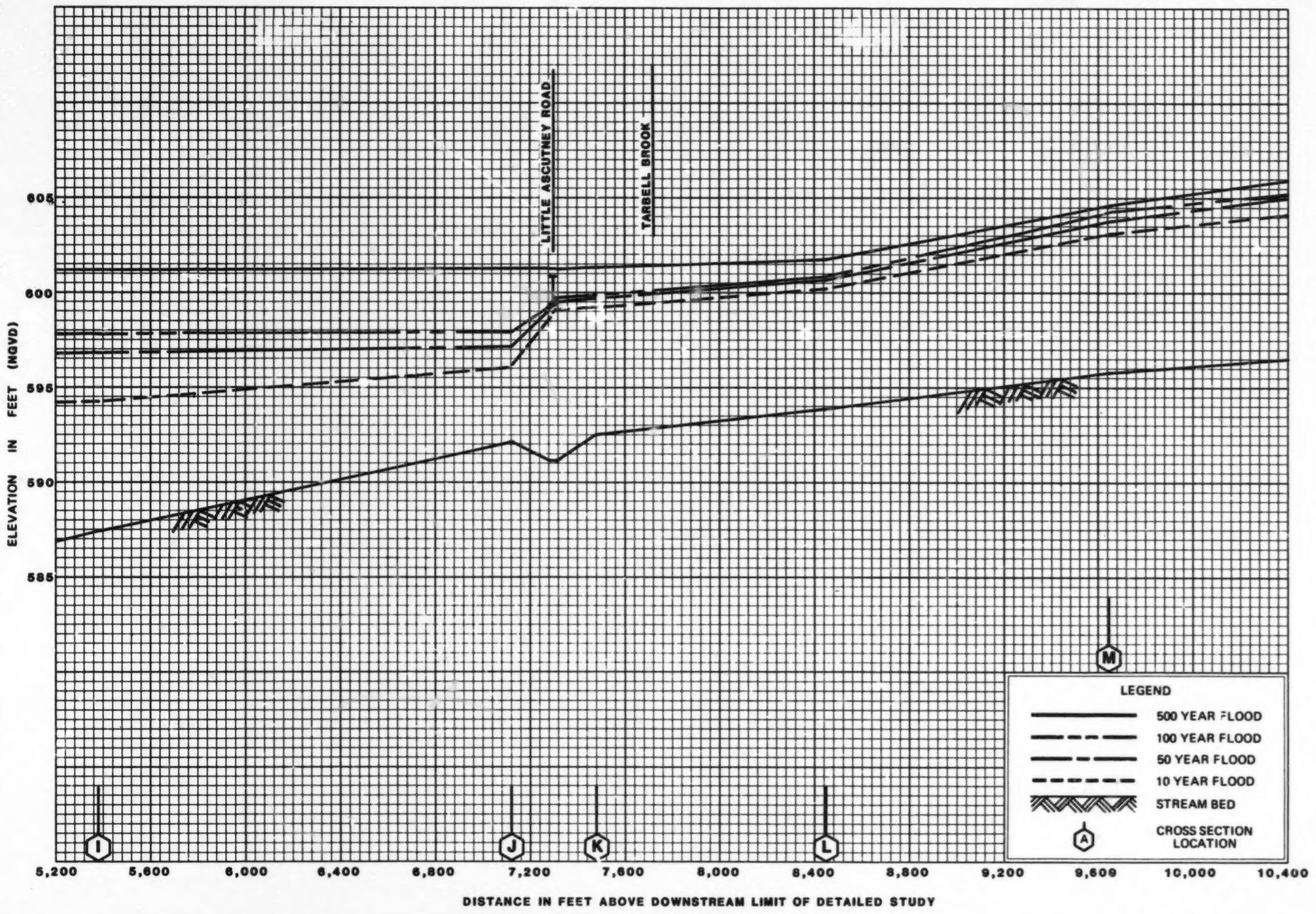
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

09P

BEST COPY AVAILABLE



FLOOD PROFILES

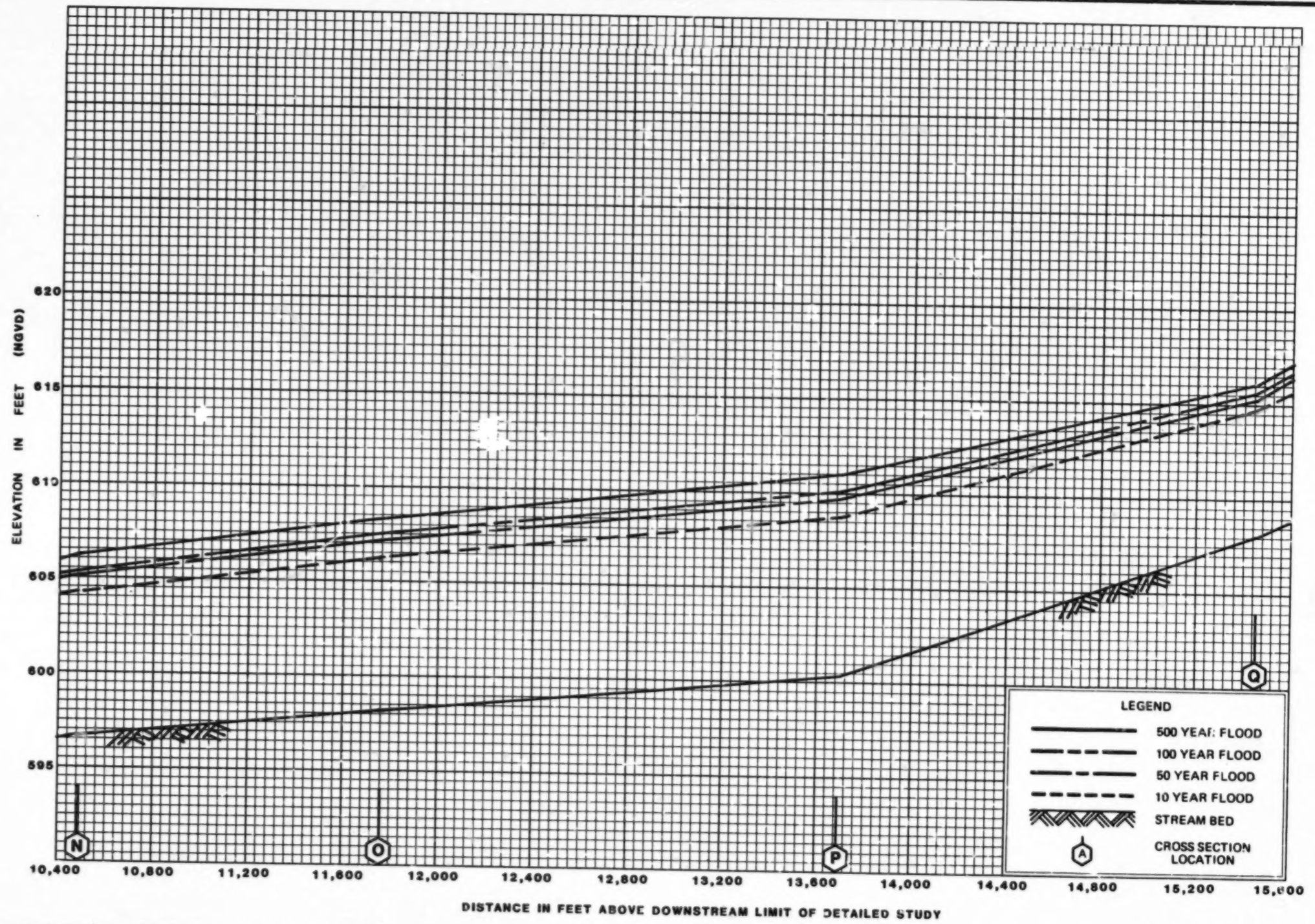
NORTH BRANCH BLACK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT.
(WINDSOR CO.)

10P

BEST COPY AVAILABLE



FLOOD PROFILES

NORTH BRANCH BLACK RIVER

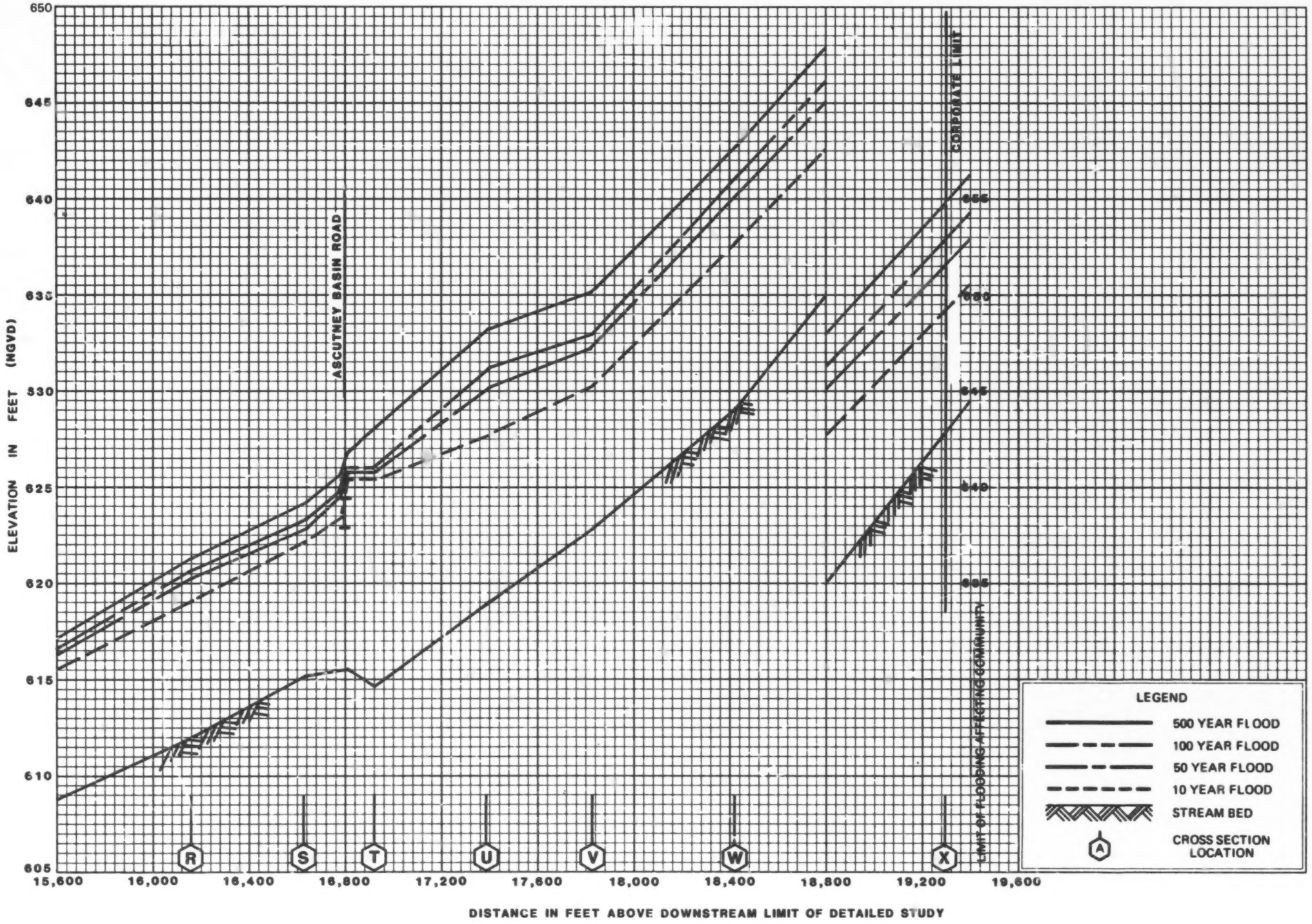
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

11P

BEST COPY AVAILABLE



FLOOD PROFILES

NORTH BRANCH BLACK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEATHERSFIELD, VT

(WINDSOR CO.)

12P

BEST COPY AVAILABLE